ON THE RHIZOSPHERE OF SOME ARGENTINE PLANTS AND ITS RELATION TO SOIL MICROFAUNA(*)

E.H. Rapoport and D.C. de Izarra (**)
Instituto de Edafología e Hidrología
Universidad Nacional del Sur, Bahía Blanca, Argentina

The rhizosphere effect, that is, the part of the soil up to where the influence of plant roots can be detected has been studied principally from a bacteriological and mycological view-point. It is a well known fact that the plant roots can influence their surroundings not only physically but also chemically by their exudates (Woods, 1960) and by providing organic matter from their dead tissues. With respect to soil fauna this phenomenon was demonstrated by the attractiveness of the rhizosphere for Nematoda (Henderson & Catznelson, 1961), Protozoa (Biczok, 1953, 1954; Roualt et al. 1960; Varga, 1958) and, in general, for parasitic insects of roots (Koehler & Gyrisco, 1959). In the Soviet Union Ghilarov (1963) and other authors speak about a *rhizofauna*, that is to say, invertebrate synusiae associated with the roots of certain plants. To avoid confusion we suggest to use *rhizoflora* for the remaining micro-organisms.

The specific association between the geoatmobiontic microfauna and the roots was studied by Muller (1959) and also by Führer (1961), the latter in relation to the mite *Pseudotritia ardua*.

The lack of studies comparing the rhizosphere of natural perennial grasses and surrounding root-free soil, stimulated us to undertake a study of the problem. On different occasions we saw a remarkable increase of the animal population density in soil samples taken from the rhizosphere. On the 8-VI-61 we made a transection in the border of a solonchak (Salitral de Grünbein, B.Blanca). Samples were taken with a cylinder of 5,2 cm.diameter (23,2 cm^2) and 7 cm.depth each 16 meters apart.

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Geoatmobiontic microfaunal population varied in the following way: 4, 3, 3, 7, 1, 9, 8, 25, 106, 103, 98, 24, 52, 54, 230, 144, 24 ,29, etc.

The maximum value, i.e. 230, corresponded precisely to the rhizosphere of Juncus acutus and this sample contained five species of Collembola not present in the other samples.

On 6-VII-60 contiguous soil samples of 10 x 10 x 7 cm were taken along 1.30 m making a transection passing through the roots of a J. acutus plant that had be cut flush with the soil surface. The figures of soil microfauna per dm^2 were 356, 186, 198, 162, 246, 50, 727, 405, 497, 302, 249, 6 and 72, of which 727,405 and 497 - the highest - corresponded to the rhizosphere zone. In the rhizosphere of this plant we found Isopoda Oniscoidea, Corrodentia, Thysanoptera, and nine species of Collembola not present outside (observations made by Rapoport & Najt).

With the object of having a statistical measure of the differences, soil samples with the above mentioned cylinder were taken in the root system of Distichlis spicata and also in Stipa brachychaeta. In the first case blanks were also taken selecting a place where plants were sufficiently separated to avoid the possibility of having secondary roots between them. This was possible in the borderline where bare saline soil begins. Soil samples for rhizoflora were collected in the same way and preserved in sterilized bags. Welch's method for comparison of statistical means was used (see Rapoport & Tagliabue, 1964).

Differences between means of microfaunal populations are significant at 95% level and the confidence limits are 55.8± 33.51.

It can be observed that the differences between rhizosphere and non rhizosphere soil are remarkable in both cases: microfauna and microflora. In the case of the solonchak with D. spicata there are special differences with respect to anaerobes, proteolytic, ammonifiers and denitrifying bacteria always more abundant in the rhizosphere. Also the Acari and Collembola prosper with them, the latter always absent outside the root zone as also

TABLE I

Solonchak with consocies of Distichlis spicata

Microfauna (28-VII-62)

	No rhizosphere										Rhizosphere									
Sample Nr	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
Pauropoda	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
Symphyla	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Acari	1	-	1	-	-	-	-	1	-	1	-	-	-	10	2	8	13	1	9	3
Homoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	5
Corrodentia	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Thysanoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Formicidae	1	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-
Insect larvae	-	-	-	-	-	-	-	-	-	-	1	2	-	-	-	1	-	-	1	-
Brach.parvula	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Tullb.krausbaueri	-	-	-	-	-	-	-	-	-	-	-	-	4	3	-	-	7	-	10	1
Seira domestica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Total	2	1	1	0	0	0	0	1	2	2	2	2	4	13	4	9	21	2	23	9
Mean	0,9										8,9									

Microflora (9-VIII-63)

		No rhizosphere		Rhizosphere
Nitrogen fixers (anaerobes)	SiG-Mannitol	1	:	1.3
	Soil plaques	-	:	+++ (P deficiencies)
Nitrogen fixers (anaerobes)		1	:	116
Proteolitics		1	:	19
Ammonifiers		1	:	41,000
Ammonium oxidizers		-	:	+
Nitrite oxidizers		-	:	+
Denitrifiers		1	:	6.000
Amylolytics		1	:	0,1
Cellulolytics		-	:	38%
Fungi		1	:	7.4
Total microflora		1	:	1

Differences between means of microfaunal populations are significant at 95% level and the confidence limits are 8 ± 5.75.

TABLE II

Pampean steppe with Stipa brachychaeta tussocks
(Figures correspond to 3 samples)

Microfauna (9-VII-63)

	No rhizosphere						Rhizosphere					
Sample Nr	1	2	3	4	5	6	1	2	3	4	5	6
Chilopoda	-	-	-	-	-	-	-	-	-	-	2	-
Acari	52	53	14	24	57	22	71	76	55	78	17	41
Pauropoda	-	-	-	-	-	-	5	3	7	19	2	28
Homoptera	-	-	-	-	-	-	-	10	2	-	1	-
Corrodentia	-	-	-	-	-	-	1	-	2	-	-	-
Isoptera	-	-	-	-	3	-	-	-	-	-	-	-
Formicidae	-	1	-	-	-	-	1	-	-	9	-	-
Insect larvae	-	-	-	-	-	-	2	3	3	2	-	-
Dinaphorura americana	-	-	-	-	-	-	-	-	-	1	2	-
Tullbergia humilis	5	3	-	-	1	-	-	-	1	-	4	-
Micronella porcus	-	-	-	-	-	-	-	2	-	3	1	7
Brachystomella parvula	-	4	1	-	-	-	1	1	1	17	7	-
Probrachystomella rhodosoma	2	-	-	3	-	-	4	8	-	-	-	-
Folsomides americanus	-	-	-	-	-	-	6	14	2	7	9	6
Isotomina thermophila	-	-	-	-	-	-	-	-	-	-	4	-
Metakatianna antennalis	-	-	-	-	-	-	-	-	-	-	5	4
Tullbergia krausbaueri	-	-	-	-	-	-	1	1	1	2	2	-
Total	60	61	15	27	61	22	92	118	74	138	56	86
Mean	40.33						96.17					

Microflora (9-VII-63)

	No rhizosphere		Rhizosphere
Nitrogen fixers(aerobies)Si.G-Mannitol	1	:	0.9
Soil plaques	-		-
Nitrogen fixers (anaerobies)	1		418
Proteolytics	1	:	10
Ammonifiers	1	:	10
Ammonium oxidizers	1	:	0.2
Nitrite oxidizers	1	:	47
Denitrifiers	1	:	0.001
Cellulolytics	1	:	2.2
Fungi	1	:	1.5
Total microflora	1	:	1.6

happens with Homoptera and insect larvae. Collembolan species are detailed in tables.

In the rhizosphere of *S.brachychaeta* there is also a large increase in the anaerobic, proteolytic and ammonifying bacteria, and also in nitrite oxidizers but a decline in denitrifiers. With respect to the microfauna, Stipa's rhizospheres shows some differences in comparison with that of *Distichlis*. The total number of Acari is similar in the rhizosphere and non rhizosphere soil, although this is not the case for the Pauropoda, Corrodentia, Homoptera, insect larvae, and species of Collembola like *D.americana*, *T.krausbaueri*, *M.porcus*, *F.americanus*, *I.thermophila* and *M. antennalis*. We do not discard the possibility that these animals are present out of the root surrounding, but in lesser number.

In *Distichlis* rhizosphere there are higher concentrations of Acari. The Homoptera, insect larvae, and Collembola are exclusively present in this zone.

There are no appreciable changes in the total sum of the microflora in the rhizosphere and non rhizosphere of *Distichlis* and *Stipa*.

Obviously, the differences between the root zone of relatively large plants as *S.brachychaeta* are not so marked when samples for comparison are taken from the root zone of very small plants (seedlings). On 5-VIII-65 we took two 10x10x2 cm samples divided in twentyfive 2 × 2 × 2 cm subsamples from a depth of 3 cm below the rhizosphere of *S.brachychaeta* and from 3 cm below very small plants at 30 cm distance from the first.

mean number of invertebrates in 2 × 2 × 2 cm samples

below S. brachychaeta		below small plants	
Acari	4.52	Acari	4.62
Collembola	7.58	Collembola	5.00
TOTAL	13.92	TOTAL	11.62

As can be seen, the rhizosphere effect is completely masked. The small differences in favor of *S.brachychaeta* are not statistically significant.

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